

**Lab Manual**  
**for**  
**AUTOMOBILE ENGINEERING**  
**LAB**  
**(Pr.1)**

**6<sup>th</sup> Semester, Mechanical Engg.**

**Prepared by**  
**Dr. Biswajit Parida**  
**Lecturer, Mechanical**



**DEPARTMENT OF MECHANICAL ENGINEERING**  
**GOVERNMENT POLYTECHNIC, KENDRAPARA**  
**Kendrapara 754289, Odisha, India**

## EXPERIMENT NO. 01

**OBJECTIVE:** Study and Demonstration of Layout of an Automobile.

**EQUIPMENT:** A working or non working model of Layout of an Automobile.

### THEORY –

#### Components of an Automobile

**1) BASIC STRUCTURE** – This is the unit on which are to be built the remainder of the units to turn it in to a power operated vehicle. It consist of frame, suspension system, axles, wheels and tyres

**Frame** – There are two distinct forms of construction

1. The conventional pressed steel frame to which all the mechanical units are attached and on which the body is superimposed.
2. The integral or frameless construction, in which the body structure is so designed as to combine the functions of body and frame, the units normally attached to the frame being attached directly to the body. Frameless construction is possible only in case of a closed car, since the roof, screen pillars, door pillars and rear panel are essential load taking parts of structure.

**Suspension System** – Functions of suspension systems are

1. To prevent the road shocks from being transmitted to the vehicle components
2. To safeguard the occupants from road shocks
3. To preserve the stability of the vehicle in pitching or rolling, while in motion

There are two types of suspension systems

1. The conventional system, in which the springs are attached to a rigid beam axle
2. The independent system, in which there is no rigid axle beam and each wheel, is free to move vertically without any reaction on the other wheel.

**Axles** – The weight carrying portions of the axles , whether it may be front or rear ,may be considered as beam supported at the ends , loaded at two intermediate points and subjected to following loads

1. The vertical load at the spring centers due to which the weight of the vehicle.
2. A fore and aft load at the wheel centre due to driving or braking effort
3. Torque reactions due to the drive or brakes.
4. A side thrust at the radius of the tyre due to centrifugal force when rounding a curve.

**Wheels** – Wire spoked wheels have been used mainly on sports cars, primarily on account of their light weight and quickness in changing the wheel. However the pressed steel wheel has displaced these all ordinary purposes. Such a wheel consists of a central flanged disc pressed in to a rolled section rim retained in position by welding. Light alloy wheels are currently used in case of luxury and sport cars.

## **2) POWER PLANT-**

The power plant provides the motive power for all the various functions which the vehicle or any part of it, may be called upon to perform. The power plant generally consists of an internal combustion engine which may be either of spark-ignition, or of compression ignition type.

## **3) TRANSMISSION SYSTEM –**

Functions of transmission system are

- 1) To disconnect the engine from the road wheels when desired
- 2) To connect the engine to driving wheels without shock
- 3) To vary the leverage between the engine and the driving wheels
- 4) To reduce the speed permanently in a fixed ratio
- 5) To turn drive through a right angle
- 6) To make a provision such that the driving wheels may rotate at different speeds while taking turns.

**Clutch** – Its purpose is to enable the driver to disconnect the drive from the road wheels instantaneously and to engage drive from the engine to the road wheels gradually while moving the vehicle from rest.

**Gear Box (Transmission)** – The gear box or transmission provides the necessary leverage variation between the engine and road wheels.

### **Bevel pinion and crown wheel –**

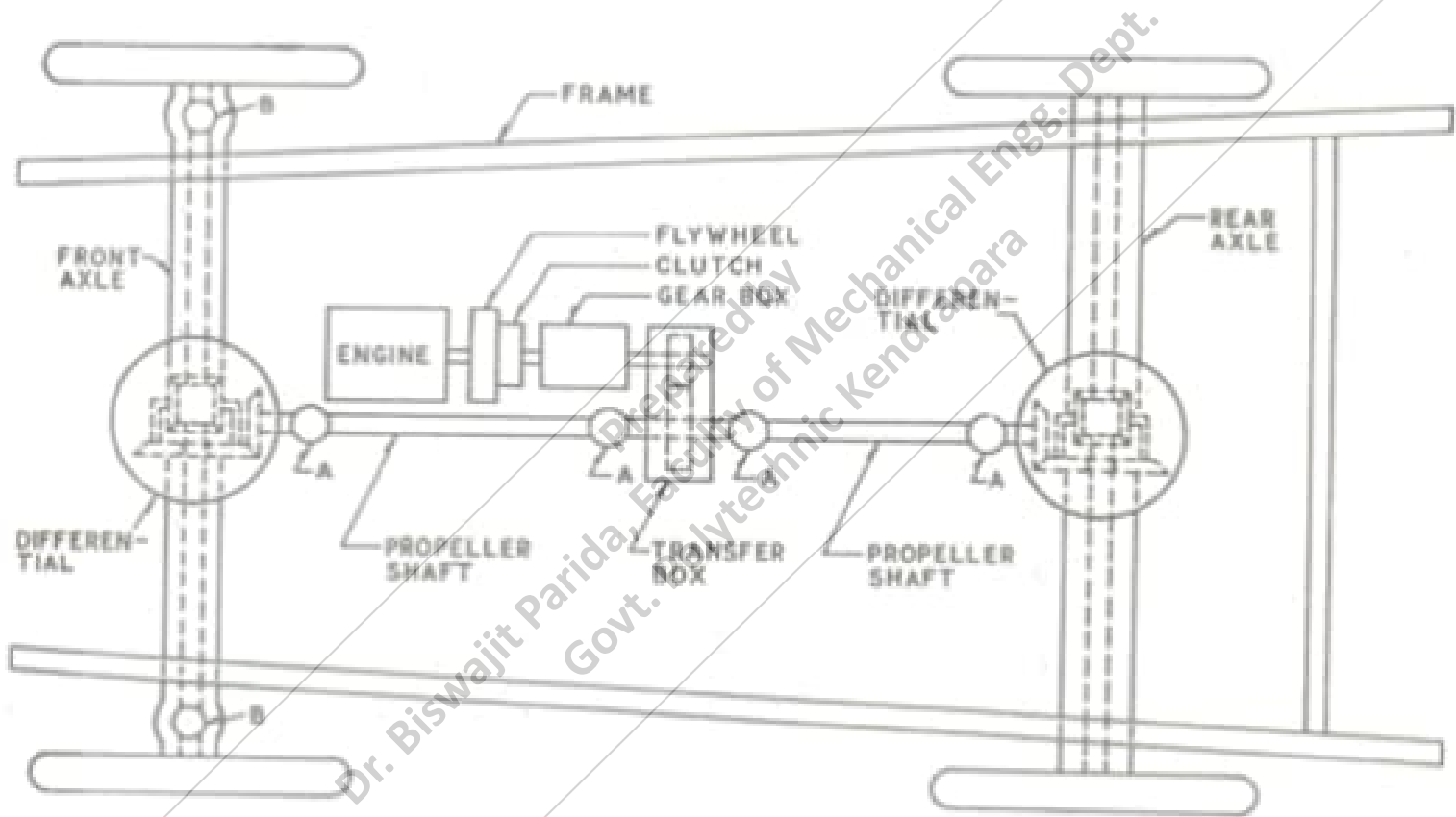
They turn the drive through 90 and also provide a permanent reduction in speed. The permanent reduction is necessitated because of the fact that speed of engine has to be maintained at optimum level at all times, yet a minimum value of torque has to be made available at the road wheels.

### **Universal joint-**

They provide for the relative movement between the engine and the driving wheels due to flexing of road springs.

### **Differential –**

While taking turns, the driving wheels must run at different speeds. This is done with the help of differential. Instead of using the long propeller shafts and transmitting the power from engine to the rear axle, a number of alternative methods have been used.



## EXPERIMENT NO.-02

**OBJECTIVE:** Study of differential gear mechanism of rear axle.

**EQUIPMENT:** A working or non working model of differential gear mechanism of any vehicle.

**THEORY:** The purpose of the differential assembly is to allow the two drive wheels to turn at different speeds when the car goes around a corner. This is necessary because when cornering, the wheel on the inside of the turn goes through a smaller arc or corner than the wheels on the outside. If the wheels were not allowed to turn at different speeds, they would tend to skip around the corner and steering would be very difficult.

Differentials are used in:

- i) The rear drive axle of front engine, rear wheel drives vehicles.
- ii) The transaxles of front engine, front wheel drive and rear engine, rear wheel drive vehicles.
- iii) The front drive axle and rear drive axle of four wheel drive vehicles.
- iv) The transfer case of some four wheel drive vehicles.

Both the front drive and rear drive differential have the same job to do. They also have many of the same parts. The basic difference is the way in which engine torque is delivered to the differential assembly.

Power enters the rear axle assembly from the final drive which consists of bevel pinion connected through a rear universal yoke to the propeller shaft. The bevel pinion is meshed with the crown wheel, which is bolted to the case. This arrangement allows the bevel pinion to turn the crown wheel.

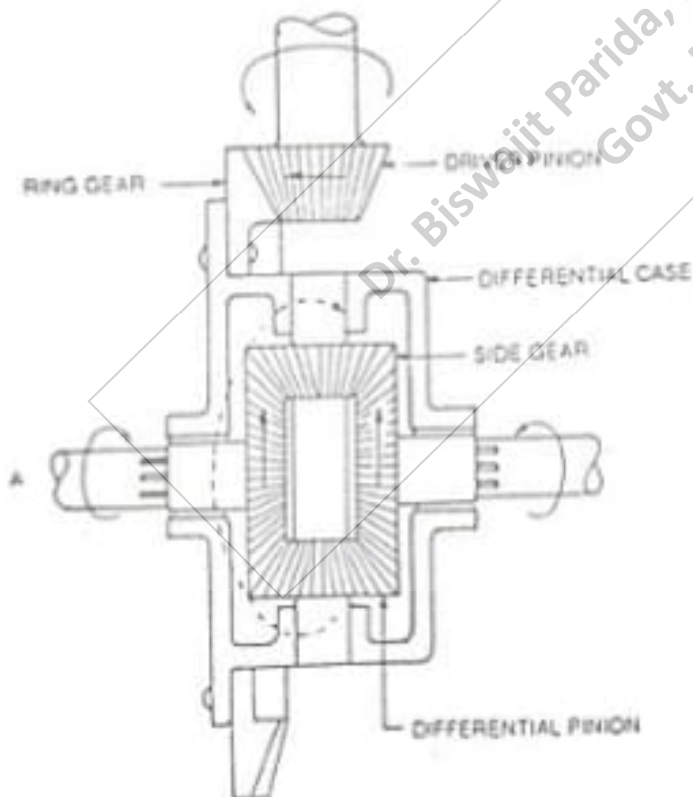
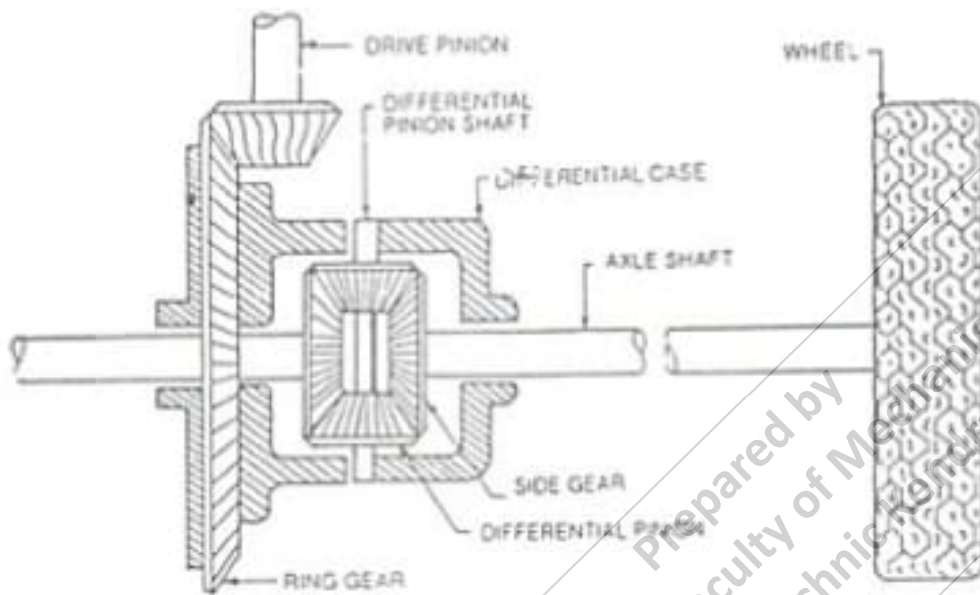
As the crown wheel turns, the case attached to it also turns. A shaft through the case also goes through the middle of two small pinion gears. As the case turns, this shaft turns the small pinion gears, each of which meshes with a side gear. Each side gear is attached to a shaft called an axle, which on a rear drive system runs through housing to one of the rear wheels.

When the automobile is travelling in a straight line, the power flow through the system is fairly simple. The crown wheel turns the case. The case, through its shaft and pinion gears, turns each of the side gears at the same speed. The axles or drive shafts turn the drive wheels, which drive the vehicle.

When the vehicle makes a turn, however, the power flow becomes more complicated. If the automobile is making a left turn, the left drive wheel must go through a sharper corner or travel through a shorter distance than the right drive wheel. The crown wheel turns the case. Since the left wheel is going through a sharp corner, the left axle is slowed or stopped

momentarily. The pinion gears in the case still turn with the case but they also rotate on the case shaft. Thus they can walk around the slowed or stopped left side gear and provide all the power to the right side gear so the right wheel will turn faster than the left wheel.

During a right turn there is more resistance on the right axle, because the right wheel must turn through a sharper corner than the left. The pinions in the case walk around the right side gear and drive the left axle gear.



## AIM OF THE EXPERIMENT

Study the electrical system of automobile.

## APPARATUS REQUIRED

SL. NO	EQUIPMENT	SPECIFICATION	QUANTITY
01	ENGINE	DIESEL	01
02	BATTERY	12VOLT.DC	01
03	CIRCUIT OF ELECTRICAL SYSTEM		

## THEORY

- ❖ The wiring circuit of a typical passenger car lighting system uses one wire for positive terminal connection and body is itself ground. The power/current is supplied to the system from the battery of 6 volt or 12 volt.
- ❖ The circuit begins at the battery and passes through the armature and a fuse before it reaches to any switch.
- ❖ The hand lamp circuit generally contains a foot operated dimmer switch which determines the flow of current to the upper or lower filament.
- ❖ The dome light is controlled either by a hand operated pillar switch or by an automatic door switch that completes the circuit.
- ❖ The stop light is controlled by stop light switch in the brake system so that when the brakes are applied the switch is ON.
- ❖ All other lights are controlled by light switch on the instrument panel.

## **CONCLUSION**

From the above experiment we have successfully studied about the electrical wiring system of an automobile

Prepared by  
Dr. Biswajit Parida, Faculty of Mechanical Engg. Dept.  
Govt. Polytechnic Kendrapara



**AIM OF THE EXPERIMENT****Study of braking system (Hydraulic /Air brake)****APPARATUS REQUIRED:-**

SL.NO	EQUIPMENT	SPECIFICATION	QUANTITY
01	MODEL OF A BRAKING SYSTEM	HYDRAULIC	01
02	HYDRAULIC OIL	SAE40	

**THEORY:-**

- ❖ A brake is a mechanical device which decreases speed of a vehicle. Its opposite component is a clutch. The function of the brakes are :-

1. To stop or slow down the vehicle in the shortest possible distance in an emergency.
2. To control the vehicle to be retained when descending a hill.

The hydraulic brakes are applied by the liquid pressure. The pedal force is transmitted to the brake shoe by means of a confined liquid through a system of force transmission.

The force applied to the pedal is multiplied and transmitted to all the brake shoes by a force transmission system.

It essentially consists of two main components i.e., master cylinder and wheel cylinder.

The master cylinder is connected by tubing to the wheel cylinder at each of the four wheels.

The system is filled with the liquid under light pressure when the brakes are not in operation.

The liquid is known as brake fluid, and is usually a mixture of glycerin and alcohol or castor oil, denatured alcohol and some additives.

**OPERATION:-**

- a. Within a hydraulic brake system, as the brake pedal is pressed, a push rod exerts force on the piston in the master cylinder causing fluid from the brake fluid reservoir to flow into a pressure chamber through a compensating port which results in an increase in the pressure of the entire hydraulic system.
- b. This pressure is conducted instantaneously to the wheel cylinder on each of four brakes, where it forces the wheel cylinder piston outwards.
- c. These pistons in turn, force the brake shoes out against the brake drums.
- d. When the driver releases the brake pedals, the master cylinder piston returns to its original position due to the return spring pressure, and thus the fluid pressure in the entire system drops to its original low value, which allows retracting springs on wheel brakes to pull the brake shoes out of contact with the brake drum into their original position. This causes the wheel cylinder pistons also to come back to their original position. Thus the brakes are released.

**CONCLUSION:-**

From the above experiment we have successfully studied about hydraulic braking system.

## EXPERIMENT NO.-

**OBJECTIVE:** Study and Demonstration of Clutches

**EQUIPMENT** – Models of clutches

### **THEORY –**

#### **Introduction-**

The power developed by the engines is delivered to the driving wheels of the automobile by the power train. The transmission is the major part of the power train. In the manual transmission, clutch is a device used to connect and disconnect engine power flow to the transmission the will of the driver. The driver operates the clutch via a clutch pedal inside the vehicle.

When the clutch pedal is depressed, the three main clutch assembly components – flywheel, friction disc and pressure plate are disengaged, interruption of the power flows. As the clutch is release, the pressure plate moves closer to the clutch disc.

#### **Functions of Clutch –**

1. To permit the engagement or disengagement of a gear when the vehicle is stationary and engine is running.
2. To transmit the engine power to the road wheels smoothly without shock / jerk to the transmission system.
3. To permit the engaging of gears when the vehicle is in motion without damaging the gear wheels.

### **WORKING PRINCIPLE –**

The working principle of clutch is based on friction .When the two friction surfaces re brought in contact with each other and pressed they are united due to friction between them .If now one is resolved ,the other will also resolve. One surface is considered as a driving member and other as driven member. The driving member is kept rotating .When the driven member is brought in contact with the driving member, it is also starts rotating .When the driven member is separated from the driving member, and it stops revolving. The driving member of clutch is the flywheel mounted on crankshaft, the driven member is a pressure plate mounted on the transmission shaft.

## 2. MULTIPLE CLUTCHES:

A multiplate clutch consists of more than one clutch plate. As the numbers of clutch plates are increased, the friction surface also increases. The increased number of friction surfaces increases the capacity of the clutch to transmit torque.

The plates are alternately fitted to the engine shaft and gear box shaft. They are firmly pressed by the strong coil springs and assembled. Each of the alternate plate slides on splines on the pressure plate.

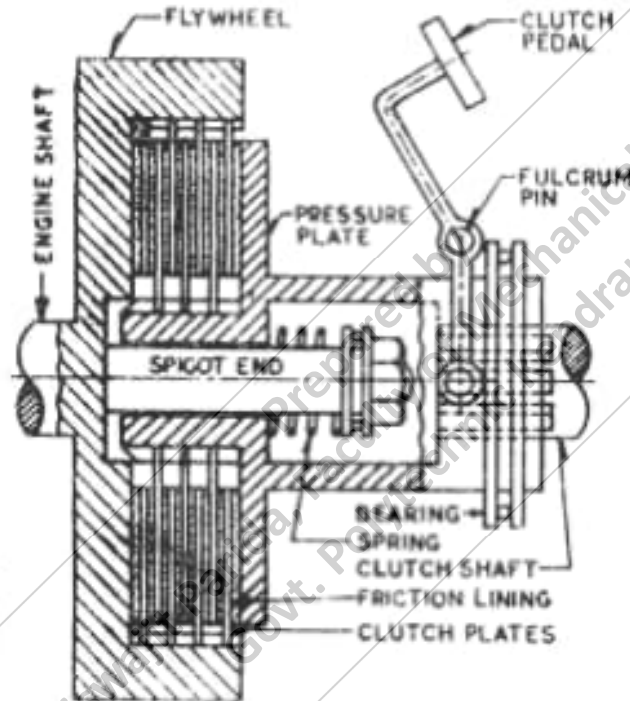


Fig. 3.21 Multiplate Clutch.

A multiplate clutch works in the same way as a single plate clutch while the flywheel is rotating, the pressure plate rotate and press against the friction plate. This causes the clutch plate to rotate, which in turn rotate the clutch shaft. When the pedal is pressed, the flywheel continues to rotate but the clutch plate is released. This happens because they are not fully pressed by the pressure plates. Thus the clutch shaft also stops rotating.

A multiplate clutch may be dry or wet. When the clutch is operated in an oil bath, it is called as a wet clutch. When the clutch is operated dry, it is called dry clutch.

### Advantages:

1. The number of friction surfaces increases the capacity of the clutch to transmit torque. Therefore, considering the same torque transmission the overall diameter of the multiplate clutch is reduced when compared to a single plate clutch.

## AIM OF THE EXPERIMENT

Study and demonstration of different circuit of carburetor.

## APPARATUS REQUIRED

<i>SL.NO</i>	<i>EQUIPMENT</i>	<i>SPECIFICATION</i>	<i>QUANTITY</i>
01	Model of a carburetor	Simple	01

## THEORY:-

The carburetor is a device for atomizing and vaporizing the fuel and mixing it with the air in carrying proportion to suit the changing condition of spark ignition engine. The air fuel mixture so obtained from the carburetor is called the combustible mixture. The process of mixing the gasoline fuel with air is called carburetion.

## **MAIN PARTS OF SIMPLE CARBURETOR:-**

- i) Venture
- ii) Throttle valve
- iii) Metering system

### **Venture:-**

- ❖ A venture is a narrow space, through which the air passes at a high speed.
- ❖ There is a discharge jet which is usually located just below the narrowest section of the venture, so that the suction is greatest.
- ❖ There is a mixing chamber just below the discharge jet, which mixes gasoline spread from nozzle and the air entering through venture forming a combustible mixture. This mixture then passes through the intake main fold into the cylinder.

### **Throttle valve:-**

- ❖ The Throttle valve is like a circular disk which is located in the mixing chamber. It is connected to accelerator pedal in the drivers compartment.
- ❖ The operator which operates the accelerator pedal according to the operating requirement and the throttle valve is adjusted simultaneously.
- ❖ When tilted is open, more air fuel mixture goes to the cylinder developing more power and tends to run faster.
- ❖ When tilted is close, less air fuel mixture goes to the cylinder developing less power and tends to run slowly.

### **Metering system:-**

- ❖ To maintain correct air fuel mixture at high speed some automatic compensating devices must be provided which acts either to increase the air supply or to increase the fuel supply as the suction above the jet increase or decreases.
- ❖ The compensating devices used are metering rods, air-bleed jet, economizers, compound jets, auxiliary air valve, these are used to determine the metering system.

## **CONCLUSION**

From the above experiment we have successfully studied about simple carburetor.

## AIM OF THE EXPERIMENT

Checking the spark plug, setting the port and check the ignition in the spark plug.

## APPRATUS REQUIRED

<i>SL.NO</i>	<i>EQUIPMENTS</i>	<i>SPECIFICATION</i>	<i>QUANTITY</i>
01	Model of a spark plug		01
02	Condenser		01
03	Distributor		01
04	Battery	12v	01

## THEORY:-

- ❖ Spark plug is device to produce electric spark to ignite the compressed air-fuel mixture inside the engine cylinder .The spark plug is screwed in the top of the cylinder, so that its electrodes projects in the combustion chamber.
- ❖ It must produce the spark at the correct movement at the end of the compression stroke.
- ❖ A proper gap is to be maintained between the two electrodes of the spark plug, so that the sparking may takes place.
- ❖ When the spark plug is screwed in the cylinder head, the ground electrode is said to be connected with ground.

- ❖ The terminal of the centre electrode is directly connected with H.T. lead of the ignition coil in case of single cylinder engine, or through the distributor in case of multi cylinder engine.
- ❖ The secondary circuit of the electrical system is to be completed through the gap between the electrodes. When the H.T. current passes through the circuit, it jumps the gap producing a spark, which ignites the compressed air fuel mixture in the cylinder.

### **CONSTRUCTION:-**

A spark plug is a device consists of mainly three parts:-

1. centre electrode or insulated electrode.
2. ground electrode or insulated electrode.
3. Insulation separating the two electrodes.

- ❖ The upper end of the centre electrode is connected to the spark plug terminal, where H.T cable from the ignition coil is connected. It is surrounded by porcelain insulator.
- ❖ The lower half portion of the insulator is fastened with a metal shell. The lower portion of the shell has a short electrode attached to one side and bent in towards the centre electrodes, so that there is a gap between the two electrodes.
- ❖ The two electrodes are thus separated by insulator. The sealing gaskets are provided between the insulator and the shell to prevent the escape of gases under various temperature and pressure condition.
- ❖ The lower part of the shell has screw threads and the upper part is made in hexagonal shape like a nut, so that the spark plug may be screwed in or unscrewed from the cylinder head.
- ❖ The material used in the construction of a spark plug are as follows:-

#### **1. SHELL:-STEEL**

**2.INSULATION:-** PORCELAIN,MICA(the porcelain has disadvantages of brittleness and low resistance to thermal shocks .mica is somewhat attacked by fuels ,sintered alumina is now almost extensively used for insulation.).

**3.ELECTRODE:-** Nickel, alloy of nickel, manganese and silicon , Platinum alloys are better for electrodes ,but their high cost limit their use.

### **PROCEDURE**

- ⇒ First connect the terminal of the condenser to the terminal of the battery
- ⇒ Then connect the black terminal to positive and red terminal to negative terminal of the battery from the condenser.
- ⇒ Then ON the main switch of the spark plug model.
- ⇒ When we switch is ON , the ignition system supply high voltage surges of current to the spark plug .

- ⇒ The ignition coil steps 12 volts from the battery to the high tension voltage of about 20,000 to 30,000 volts required to jump the spark at the spark plug gap, which ignites the combustible charge in the engine cylinder.
- ⇒ The rotor of the distributor revolves and distributes the current to the four segments which in turn, send it to the spark plugs.
- ⇒ The distributor then directs this high voltage to the proper spark plug when it jumps the gap, producing a spark which ignites the combustible mixture in the cylinder.

## **CONCLUSION**

From the above experiment we have successfully set the port and checked the ignition in the spark plug.